

THE ASTROPHYSICAL JOURNAL  
CONTENTS OF VOLUME 551, PART 1

2001 APRIL 10, NUMBER 1

	Page
EDITORIAL: THE FUTURE OF THE <i>ASTROPHYSICAL JOURNAL</i> <i>Robert C. Kennicutt, Jr.</i>	1
SECONDARY COSMIC MICROWAVE BACKGROUND ANISOTROPIES FROM COSMOLOGICAL REIONIZATION <sup>Ⓔ</sup> <i>Nikolay Y. Gnedin &amp; Andrew H. Jaffe</i>	3
EVOLUTION OF THE CLUSTER MASS FUNCTION: Gpc <sup>3</sup> DARK MATTER SIMULATIONS <i>Paul Bode, Neta A. Bahcall, Eric B. Ford, &amp; Jeremiah P. Ostriker</i>	15
A MULTIVARIATE ANALYSIS OF GALAXIES IN THE HUBBLE DEEP FIELD-NORTH <sup>Ⓔ</sup> <i>Michael R. Corbin, Andrea Urban, Elizabeth Stobie, Rodger I. Thompson, &amp; Glenn Schneider</i>	23
A SEARCH FOR THE DAMPED Ly $\alpha$ ABSORBER AT $z = 1.86$ TOWARD QSO 1244+3443 WITH NICMOS <i>Varsha P. Kulkarni, John M. Hill, Glenn Schneider, Ray J. Weymann, Lisa J. Storrie-Lombardi, Marcia J. Rieke, Rodger I. Thompson, &amp; Buell T. Jannuzi</i>	37
CORRELATIONS IN THE Ly $\alpha$ FOREST: TESTING THE GRAVITATIONAL INSTABILITY PARADIGM <sup>Ⓔ</sup> <i>Matias Zaldarriaga, Uros Seljak, &amp; Lam Hui</i>	48
IONIZATION SOURCES AND PHYSICAL CONDITIONS IN THE DIFFUSE IONIZED GAS HALOS OF FOUR EDGE-ON GALAXIES <i>Joseph A. Collins &amp; Richard J. Rand</i>	57
SYSTEMATIC ERRORS IN THE ESTIMATION OF BLACK HOLE MASSES BY REVERBERATION MAPPING <i>Julian H. Krolik</i>	72
POPULATING STELLAR ORBITS INSIDE A ROTATING, GASEOUS BAR <i>Eric I. Barnes &amp; Joel E. Tohline</i>	80
CONTINUUM VARIABILITY OF ACTIVE GALACTIC NUCLEI IN THE OPTICAL-ULTRAVIOLET RANGE <sup>Ⓔ</sup> <i>Dario Trèvese, Richard G. Kron, &amp; Alessandro Bunone</i>	103
THE RELATIVE STAR FORMATION HISTORIES OF SPIRAL BULGES AND ELLIPTICAL GALAXIES IN THE HUBBLE DEEP FIELDS <sup>Ⓔ</sup> <i>Richard S. Ellis, Roberto G. Abraham, &amp; Mark Dickinson</i>	111
COOLING FLOWS AND QUASARS. II. DETAILED MODELS OF FEEDBACK-MODULATED ACCRETION FLOWS <i>Luca Ciotti &amp; Jeremiah P. Ostriker</i>	131
METALLICITY GRADIENTS IN X-RAY CLUSTERS OF GALAXIES <i>Sabrina De Grandi &amp; Silvano Molendi</i>	153
A MOVING COLD FRONT IN THE INTERGALACTIC MEDIUM OF A3667 <i>A. Vikhlinin, M. Markevitch, &amp; S. S. Murray</i>	160
MULTIWAVELENGTH STUDY OF THE QUASAR PKS 0528+134 <i>B. Peng, R. Nan, A. Kraus, T. P. Krichbaum, A. Witzel, Y. Su, H. Zhang, C. Jin, S. Qian, &amp; S. Britzen</i>	172
THE X-RAY EMISSION OF 3C 346 AND ITS ENVIRONMENT <i>D. M. Worrall &amp; M. Birkinshaw</i>	178
THE BROADBAND SPECTRUM OF 3C 120 OBSERVED BY BEPOSAX <i>Andrzej A. Zdziarski &amp; Paola Grandi</i>	186
THE CUSPY LINER NUCLEUS OF THE S0/A GALAXY NGC 2681 <i>Michele Cappellari, Francesco Bertola, David Burstein, Lucio M. Buson, Laura Greggio, &amp; Alvio Renzini</i>	197
THE OPTICAL-NEAR-INFRARED SPECTRUM OF THE M87 JET FROM HUBBLE SPACE TELESCOPE OBSERVATIONS <i>Eric S. Perlman, John A. Biretta, William B. Sparks, F. Duccio Macchetto, &amp; J. Patrick Leahy</i>	206

	Page
ENHANCED MICROLENSING BY STARS AROUND THE BLACK HOLE IN THE GALACTIC CENTER <i>Tal Alexander &amp; Abraham Loeb</i>	223
A TEST FOR THE NATURE OF THE TYPE Ia SUPERNOVA EXPLOSION MECHANISM <i>Philip A. Pinto, Ronald G. Eastman, &amp; Tamara Rogers</i>	231
SEARCH FOR REDSHIFTED ANNIHILATION RADIATION FROM THE CRAB PULSAR <i>M. P. Ulmer, S. M. Matz, J. E. Grove, M. S. Strickman, J. D. Kurfess, M. Ruderman, T. Zhu, &amp; C. Ho</i>	244
NEUTRINO AFTERGLOWS AND PROGENITORS OF GAMMA-RAY BURSTS <i>Z. G. Dai &amp; T. Lu</i>	249
MOLECULAR TRACERS OF THE CENTRAL 12 PARSECS OF THE GALACTIC CENTER <span style="float: right;">Ⓔ</span> <i>Melvyn C. H. Wright, Alison L. Coil, Robeson S. McGary, Paul T. P. Ho, &amp; Andrew. I. Harris</i>	254
THE DIRTY MODEL. I. MONTE CARLO RADIATIVE TRANSFER THROUGH DUST <i>Karl D. Gordon, K. A. Misselt, Adolf N. Witt, &amp; Geoffrey C. Clayton</i>	269
THE DIRTY MODEL. II. SELF-CONSISTENT TREATMENT OF DUST HEATING AND EMISSION IN A THREE-DIMENSIONAL RADIATIVE TRANSFER CODE <i>K. A. Misselt, Karl D. Gordon, Geoffrey C. Clayton, &amp; M. J. Wolff</i>	277
GREAT CIRCLE TIDAL STREAMS: EVIDENCE FOR A NEARLY SPHERICAL MASSIVE DARK HALO AROUND THE MILKY WAY <i>Rodrigo Ibata, Geraint F. Lewis, Michael Irwin, Edward Totten, &amp; Thomas Quinn</i>	294
TWO-DIMENSIONAL MAGNETOHYDRODYNAMIC NUMERICAL SIMULATIONS OF MAGNETIC RECONNECTION TRIGGERED BY A SUPERNOVA SHOCK IN THE INTERSTELLAR MEDIUM: GENERATION OF X-RAY GAS IN THE GALAXY <i>Syuniti Tanuma, Takaaki Yokoyama, Takahiro Kudoh, &amp; Kazunari Shibata</i>	312
A SPECTRAL LINE SURVEY FROM 138.3 TO 150.7 GHz TOWARD ORION-KL <i>Chang Won Lee, Se-Hyung Cho, &amp; Sung-Min Lee</i>	333
THE DECELERATION OF GIANT HERBIG-HARO FLOWS <span style="float: right;">Ⓔ</span> <i>Elisabete M. de Gouveia Dal Pino</i>	347
INFRARED PROPERTIES OF WEAK RADIO SOURCES IN THE $\rho$ OPHIUCHI MOLECULAR CLOUD <i>Bruce A. Wilking, Sylvain Bontemps, Richard E. Schuler, Thomas P. Greene, &amp; Philippe André</i>	357
SINGULAR ISOTHERMAL DISKS. II. NONAXISYMMETRIC BIFURCATIONS AND EQUILIBRIA <i>Daniele Galli, Frank H. Shu, Gregory Laughlin, &amp; Susana Lizano</i>	367
INTRINSIC SHAPES OF MOLECULAR CLOUD CORES <span style="float: right;">Ⓔ</span> <i>C. E. Jones, Shantanu Basu, &amp; John Dubinski</i>	387
THE SOUTHERN GALACTIC PLANE SURVEY: THE TEST REGION <i>N. M. McClure-Griffiths, A. J. Green, John M. Dickey, B. M. Gaensler, R. F. Haynes, &amp; M. H. Wieringa</i>	394
MICROSTRUCTURE OF THE LOCAL INTERSTELLAR CLOUD AND THE IDENTIFICATION OF THE HYADES CLOUD <i>Seth Redfield &amp; Jeffrey L. Linsky</i>	413
NEUTRINO-DRIVEN JETS AND RAPID-PROCESS NUCLEOSYNTHESIS <i>Shigehiro Nagataki</i>	429
SEPARATING THERMAL AND NONTHERMAL X-RAYS IN SUPERNOVA REMNANTS. I. TOTAL FITS TO SN 1006 AD <i>K. K. Dyer, S. P. Reynolds, K. J. Borkowski, G. E. Allen, &amp; R. Petre</i>	439
EVIDENCE FOR RESIDUAL MATERIAL IN ACCRETION DISK GAPS: CO FUNDAMENTAL EMISSION FROM THE T TAURI SPECTROSCOPIC BINARY DQ TAURI <i>John S. Carr, Robert D. Mathieu, &amp; Joan R. Najita</i>	454
EARLY DUST EVOLUTION IN PROTOSTELLAR ACCRETION DISKS <i>Gerhard Suttner &amp; Harold W. Yorke</i>	461
BORON IN PRESOLAR SILICON CARBIDE GRAINS FROM SUPERNOVAE <i>P. Hoppe, K. Lodders, R. Strebel, S. Amari, &amp; R. S. Lewis</i>	478
IDENTIFICATION OF Fe II EMISSION LINES IN FUSE STELLAR SPECTRA <i>Graham M. Harper, Erik Wilkinson, Alexander Brown, Carole Jordan, &amp; Jeffrey L. Linsky</i>	486
MODELING THE INTERSTELLAR MEDIUM-STELLAR WIND INTERACTIONS OF $\lambda$ ANDROMEDAE AND $\epsilon$ INDI <i>Hans-Reinhard Müller, Gary P. Zank, &amp; Brian E. Wood</i>	495

# CONTENTS

v

FIRST RESULTS FROM THE ANGLO-AUSTRALIAN PLANET SEARCH: A BROWN DWARF CANDIDATE AND A 51 PEG-LIKE PLANET <i>C. G. Tinney, R. Paul Butler, Geoffrey W. Marcy, Hugh R. A. Jones, Alan J. Penny, Steven S. Vogt, Kevin Apps, &amp; Gregory W. Henry</i>	Page 507
THE INNER NEBULA AND CENTRAL BINARY OF THE SYMBIOTIC STAR HM SAGITTAE <i>S. P. S. Eyres, M. F. Bode, A. R. Taylor, M. M. Crocker, &amp; R. J. Davis</i>	512
THE BISMUTH ABUNDANCE IN THE HgMn STARS $\chi$ LUPI AND HR 7775 AND IMPROVED ATOMIC DATA FOR SELECTED TRANSITIONS OF Bi I, Bi II, AND Bi III $\oplus$ <i>G. M. Wahlgren, T. Brage, J. C. Brandt, J. Fleming, S. Johansson, D. S. Leckrone, C. R. Proffitt, J. Reader, &amp; C. J. Sansonetti</i>	520
ANALYSIS OF HYDRODYNAMIC STABILITY OF SOLAR TACHOCLINE LATITUDINAL DIFFERENTIAL ROTATION USING A SHALLOW-WATER MODEL <i>Mausumi Dikpati &amp; Peter A. Gilman</i>	536
A REDUCED MAGNETOHYDRODYNAMIC MODEL OF CORONAL HEATING IN OPEN MAGNETIC REGIONS DRIVEN BY REFLECTED LOW-FREQUENCY ALFVÉN WAVES <i>S. Oughton, W. H. Matthaeus, P. Dmitruk, L. J. Milano, G. P. Zank, &amp; D. J. Mullan</i>	565
TOWARD A MEAN FIELD FORMULATION OF THE BABCOCK-LEIGHTON TYPE SOLAR DYNAMO. I. $\alpha$ -COEFFICIENT VERSUS DURNEY'S DOUBLE-RING APPROACH <i>Dibyendu Nandy &amp; Arnab Rai Choudhuri</i>	576
A QUADRUPLE MAGNETIC SOURCE MODEL FOR ARCADE FLARES AND X-RAY ARCADE FORMATIONS OUTSIDE ACTIVE REGIONS. II. DARK FILAMENT ERUPTION AND THE ASSOCIATED ARCADE FLARE <i>S. Hirose, Y. Uchida, S. Uemura, T. Yamaguchi, &amp; S. B. Cable</i>	586
ERRATUM	597
2001 APRIL 20, NUMBER 2	
PHOTON CONSUMPTION IN MINIHALOS DURING COSMOLOGICAL REIONIZATION $\oplus$ <i>Zoltán Haiman, Tom Abel, &amp; Piero Madau</i>	599
FORMATION OF DISK GALAXIES: WARM DARK MATTER AND THE ANGULAR MOMENTUM PROBLEM <i>Jesper Sommer-Larsen &amp; Alexandre Dolgov</i>	608
FIRST RESULTS FROM THE X-RAY AND OPTICAL SURVEY OF THE CHANDRA DEEP FIELD SOUTH <i>R. Giacconi, P. Rosati, P. Tozzi, M. Nonino, G. Hasinger, C. Norman, J. Bergeron, S. Borgani, R. Gilli, R. Gilmozzi, &amp; W. Zheng</i>	624
THE POWER SPECTRUM OF RICH CLUSTERS ON NEAR-GIGAPARSEC SCALES <i>Christopher J. Miller &amp; David J. Batuski</i>	635
WEAK-LENSING DETERMINATION OF THE MASS IN GALAXY HALOS $\oplus$ <i>D. R. Smith, G. M. Bernstein, P. Fischer, &amp; M. Jarvis</i>	643
ARP 119: A HIGH-SPEED GALAXY COLLISION WITH EPISODIC STAR FORMATION $\oplus$ <i>Nathan C. Hearn &amp; Susan A. Lamb</i>	651
SPACE TELESCOPE IMAGING SPECTROGRAPH ECHELLE OBSERVATIONS OF THE SEYFERT GALAXY NGC 4151: PHYSICAL CONDITIONS IN THE ULTRAVIOLET ABSORBERS <i>S. B. Kraemer, D. M. Crenshaw, J. B. Hutchings, I. M. George, A. C. Danks, T. R. Gull, M. E. Kaiser, C. H. Nelson, D. Weistrop, &amp; G. L. Vieira</i>	671
MOLECULAR GAS AND STAR FORMATION IN THE NUCLEUS OF IC 342: C <sup>18</sup> O AND MILLIMETER CONTINUUM IMAGING <i>David S. Meier &amp; Jean L. Turner</i>	687
RADIO CONTINUUM IMAGING OF THE SPIRAL GALAXY NGC 4258 <i>Scott D. Hyman, Daniel Calle, Kurt W. Weiler, Christina K. Lacey, Schuyler D. Van Dyk, &amp; Richard Sramek</i>	702
MULTIFRACTAL SCALING, GEOMETRICAL DIVERSITY, AND HIERARCHICAL STRUCTURE IN THE COOL INTERSTELLAR MEDIUM <i>David Chappell &amp; John Scalzo</i>	712
ARP 220: A CIRCUMNUCLEAR POLAR RING AS AN ALTERNATIVE TO A DOUBLE NUCLEUS? <i>A. Eckart &amp; D. Downes</i>	730
CONSTRAINTS ON STIRRING AND DISSIPATION OF MHD TURBULENCE IN MOLECULAR CLOUDS <i>Shantanu Basu &amp; Chigurupati Murali</i>	743

	Page
THE STRUCTURE OF FOUR MOLECULAR CLOUD COMPLEXES IN THE BU-FCRAO MILKY WAY GALACTIC RING SURVEY <i>Robert Simon, James M. Jackson, Dan P. Clemens, T. M. Bania, &amp; Mark H. Heyer</i>	747
CHEMICAL COMPOSITION AND ORIGIN OF NEBULAE AROUND LUMINOUS BLUE VARIABLES <i>Henny J. G. L. M. Lamers, Antonella Nota, Nino Panagia, Linda J. Smith, &amp; Norbert Langer</i>	764
OBSERVATIONS OF THE INTERSTELLAR MEDIUM IN THE MAGELLANIC BRIDGE <i>N. Lehner, K. R. Sembach, P. L. Dufton, W. R. J. Rolleston, &amp; F. P. Keenan</i>	781
THE CO $J = 2-1/J = 1-0$ RATIO IN THE LARGE MAGELLANIC CLOUD <i>K. Sorai, T. Hasegawa, R. S. Booth, M. Rubio, J.-I. Morino, L. Bronfman, T. Handa, M. Hayashi, L.-Å. Nyman, T. Oka, S. Sakamoto, M. Seta, &amp; K. S. Usuda</i>	794
FUNCTIONAL MOLECULAR GROUPS ON INTERSTELLAR GRAINS <i>J. M. Hollis &amp; E. Churchwell</i>	803
INFRARED EMISSION FROM INTERSTELLAR DUST. I. STOCHASTIC HEATING OF SMALL GRAINS <i>B. T. Draine &amp; Aigen Li</i>	807
[O II] AS A TRACER OF CURRENT STAR FORMATION <i>Rolf A. Jansen, Marijn Franx, &amp; Daniel Fabricant</i>	825
OXYGEN IN THE VERY EARLY GALAXY <i>Garik Israelian, Rafael Rebolo, Ramón J. García López, Piercarlo Bonifacio, Paolo Molaro, Gibor Basri, &amp; Nataliya Shchukina</i>	833
THE EQUILIBRIUM STATE OF MOLECULAR REGIONS IN THE OUTER GALAXY <sup>Ⓔ</sup> <i>Mark H. Heyer, John M. Carpenter, &amp; Ronald L. Snell</i>	852
ON THE OPTICAL PULSATIONS FROM THE GEMINGA PULSAR <i>Janusz A. Gil, David G. Khechinashvili, &amp; George I. Melikidze</i>	867
ROSSBY WAVE INSTABILITY OF THIN ACCRETION DISKS. III. NONLINEAR SIMULATIONS <i>H. Li, S. A. Colgate, B. Wendroff, &amp; R. Liska</i>	874
SUPER-EDDINGTON ATMOSPHERES THAT DO NOT BLOW AWAY <i>Mitchell C. Begelman</i>	897
AN ATLAS OF BURST OSCILLATIONS AND SPECTRAL PROPERTIES IN 4U 1728-34 <i>Steve van Straaten, Michiel van der Klis, Erik Kuulkers, &amp; Mariano Méndez</i>	907
THE QUIESCENT X-RAY SPECTRUM OF THE NEUTRON STAR IN CENTAURUS X-4 OBSERVED WITH CHANDRA/ACIS-S <i>Robert E. Rutledge, Lars Bildsten, Edward F. Brown, George G. Pavlov, &amp; Vyacheslav E. Zavlin</i>	921
ASCA OBSERVATION OF THE LENSED BLAZAR PKS 1830-211: AN IMPLICATION OF X-RAY MICROLENSING <i>T. Oshima, K. Mitsuda, N. Ota, A. Yonehara, M. Hattori, T. Mihara, &amp; Y. Sekimoto</i>	929
ULTRA-EFFICIENT INTERNAL SHOCKS <i>Shiho Kobayashi &amp; Re'em Sari</i>	934
WIND INTERACTION MODELS FOR THE AFTERGLOWS OF GRB 991208 AND GRB 000301C <i>Zhi-Yun Li &amp; Roger A. Chevalier</i>	940
TRANS-RELATIVISTIC BLAST WAVES IN SUPERNOVAE AS GAMMA-RAY BURST PROGENITORS <i>Jonathan C. Tan, Christopher D. Matzner, &amp; Christopher F. McKee</i>	946
CEPHEID CALIBRATION OF THE PEAK BRIGHTNESS OF TYPE Ia SUPERNOVAE. X. SN 1991T IN NGC 4527 <i>A. Saha, Allan Sandage, Frank Thim, Lukas Labhardt, G. A. Tammann, J. Christensen, N. Panagia, &amp; F. D. Macchetto</i>	973
3EG J2016+3657: CONFIRMING AN EGRET BLAZAR BEHIND THE GALACTIC PLANE <i>J. P. Halpern, M. Eracleous, R. Mukherjee, &amp; E. V. Gotthelf</i>	1016
THE EARLY X-RAY EMISSION FROM V382 VELORUM (NOVA VELORUM 1999): AN INTERNAL SHOCK MODEL <i>Koji Mukai &amp; Manabu Ishida</i>	1024
EVIDENCE FOR EXTINCTION AND ACCRETION VARIABILITY IN T TAURI SOUTH <i>Tracy L. Beck, L. Prato, &amp; M. Simon</i>	1031
HELIUM EMISSION FROM CLASSICAL T TAURI STARS: DUAL ORIGIN IN MAGNETOSPHERIC INFALL AND HOT WIND <i>Georgina Beristain, Suzan Edwards, &amp; John Kwan</i>	1037

# CONTENTS

vii

PRESOLAR GRAINS FROM NOVAE	Page
<i>Sachiko Amari, Xia Gao, Larry R. Nittler, Ernst Zinner, Jordi José, Margarita Hernanz, &amp; Roy S. Lewis</i>	1065
A SPATIALLY RESOLVED, SEMIEMPIRICAL MODEL FOR THE EXTENDED ATMOSPHERE OF $\alpha$ ORIONIS (M2 IAB)	1073
<i>Graham M. Harper, Alexander Brown, &amp; Jeremy Lim</i>	
ON THE FORMATION OF POLAR SPOTS IN SUN-LIKE STARS	1099
<i>Carolus J. Schrijver &amp; Alan M. Title</i>	
PLANETARY COMPANIONS TO HD 12661, HD 92788, AND HD 38529 AND VARIATIONS IN KEPLERIAN RESIDUALS OF EXTRASOLAR PLANETS	1107
<i>Debra A. Fischer, Geoffrey W. Marcy, R. Paul Butler, Steven S. Vogt, Sabine Frink, &amp; Kevin Apps</i>	